

# **NCCR Safety Site Visit Report**

## *LBNL Comments on the Draft*

We at the Lawrence Berkeley National Laboratory are very pleased with the conclusion of the NCCR safety site visit committee that the risk “to the community from the activities of the NTLF is extremely small.” We are further gratified by the committee’s effort, in the first paragraph of their report, to put the estimated exposures in the context of the much higher “natural” lifetime radiation exposures. The committee had only a single day at the Laboratory to gather and assimilate information and has produced a report that is both thoughtful and thorough. Nevertheless, we would like to offer a few comments, aimed both at correcting factual errors and at clarifying important issues. It is especially important to us to guard against possible misinterpretation or misuse of the report, its findings, and its conclusions. We also briefly describe the actions we propose to take in response to the five recommendations of the committee.

### ***Corrections and clarifications***

***Exposure to the community.*** The first page of the Safety Site Visit Report indicates that the radiation dose received by “a (hypothetical) individual both living and working for his/her entire lifetime at the perimeter of the NTLF is less than 1 mSv.” It then explains that the lifetime cancer risk from a 1-mSv exposure is about 1 in 20,000 (using a dose-to-risk conversion of 5%/Sv). We are deeply concerned that this finding, *pertaining to the immediate vicinity of the NTLF itself*, might be misconstrued. The term “perimeter” could easily be misunderstood to mean the perimeter of LBNL. Even apart from a purposeful misuse of this finding, an innocent misreading is possible for two reasons. First, the reference to a person “living and working” in this area suggests that there might, in fact, be community residents within or adjacent to this “perimeter.” And second, the section of the report in which this finding is reported is entitled “Doses and Risks to the Community,” again suggesting that there might be “community” exposures at this level.

For individuals inside LBNL and near the NTLF, direct monitoring data (based on urine analyses) are available. These data lead to an estimated exposure of 0.1 mSv for a 40-year working lifetime at the perimeter of the NTLF. *At the perimeter of LBNL*, the maximum 70-year lifetime dose is estimated to be 0.09 mSv in the Health-Risk Assessment [H-RA] by McKone and Brand, a value substantially ratified by the committee.

*In the interest of clarity, we therefore urge the committee to report lifetime exposure estimates only for zones relevant to the community, outside the perimeter of LBNL.* Estimates for hereditary and teratogenic risks are also most appropriate for such areas. In the immediate vicinity of the Facility, working/living lifetime exposure estimates are misleading, as are hereditary and teratogenic risks based on full-time residence. In this zone, we urge that estimates be given only for working lifetimes, and that additional explanation be provided to make clear that these latter exposures refer to a zone in which *no one lives*.

**Recent emissions reductions.** On page 4 of its report, the committee states that “there was little improvement [in emissions reductions] in the intervening years” (1990–99). In fact, the five-year average of annual tritium emissions declined each year from a high of 330 Ci in 1988 to 110 Ci in 1994 and 66 Ci in 1998. Many procedural and hardware changes were made between 1990 and 1999, as the NTLF staff (Mr. Hiromi Morimoto in particular) strove to decrease the tritium emissions below the already very low levels. Examples of improvements include the vacuum transfer of mixed waste from the lyophilizer to a waste container to minimize releases to the work boxes, and the encapsulation of reaction flasks in plastic bags containing silica gel to reduce work box tritium levels during reactions. In addition, the nature and number of tritium-handling activities were highly variable during this period, with new types of tritium chemistry often requiring the development of new safety procedures. The mission of the NTLF is to develop new labeling chemistry, so this issue is intrinsic to the operation of the Facility. Further, in 1998, more than 1100 Ci of legacy mixed waste was transferred from a storage matrix, oxidized to HTO, and collected. This effort was well outside the definition of normal operations. In summary, a consistently declining five-year average has been

achieved over the past decade, despite continuous changes in the number and complexity of activities and the changing scope of operations.

In addition to new and different tritium-handling procedures, the “accounting” or record-keeping of tritium emissions has changed over the past several years, with elemental tritium now being modeled with the same dose impact as HTO. This too, together with an accidental release in 1998, offset the real advances that have been made in the past few years. Nonetheless, despite all these factors, NTLF releases have remained below 3% of the NESHAP standard. The completion of legacy waste handling, recent minimization of the volume of tritium handled, and implementation of a recirculating tritium-scavenging system (all of which have been completed over the past year) will surely lead to substantially reduced tritium releases in the future.

**Minor corrections.** The remaining comments point to statements that contain minor factual errors or ambiguities. None substantially affects the conclusions of the committee report.

- At many points in the report, it is noted that “NTLF staff estimate. . .” or “NTLF staff calculate. . . .” In almost all such instances, the estimates or calculations were performed by safety and health physics professionals in the Radiological Protection Group, the Environmental Protection Group, or the Environmental Restoration Program at LBNL, not by NTLF staff.
- Page 3: The analysis of the LHS dose measurements was done by UC Berkeley and, independently, by LBNL (not by an independent company). The analysis yielded results consistent with the H-RA model results for zone 2.
- Page 10: The NTLF mixed-waste treatment process is designed to handle high-activity, low-volume tritiated mixed waste (constituting 90% of the radioactivity, but less than 10% of the volume of tritiated mixed waste at LBNL). To date only one shipment of mixed waste has gone to INEEL for treatment; that material was considered low-activity, high-volume mixed waste and constituted less than 10% of the activity, but more than 90% of LBNL’s total tritiated mixed-waste volume.

- Page 11: The July 24, 1998, release was vented through the B75, room 107, bank of hoods, not the main stack.
- Page 11, fourth sentence under “Accidents”: An unambiguous alternative wording might be: “The dose resulting from the accidental release was well below DOE reporting thresholds; nonetheless, LBNL voluntarily filed an occurrence report with the DOE.”

### ***Comments on the recommendations***

The report contains recommendations pertaining to the following five issues:

1. Appointment of a full-time, doctoral-level health physicist
2. Improvements in inventory accounting
3. The NTLF Resource Technical and Safety Advisory Committee
4. Probability of releases
5. Settings for air monitors

We believe each recommendation warrants a response.

**1. Appointment of a full-time, doctoral-level health physicist.** We agree with the committee’s conclusion that emissions reductions and other safety issues would show steadier progress if additional staff time could be focused on these matters. We propose to address this aspect of operations by combining many of the less technically demanding safety roles of the NTLF staff (especially Dr. Philip Williams, Mr. Hiromi Morimoto, and Dr. Chit Than) with the function of the Radiological Control Technician. Hence, this individual will have responsibilities ranging from packaging and characterizing waste, to the collating and trending of the myriad environmental tritium data collected under various LBNL programs. This position will encompass all safety areas, including radiological protection, waste management, environmental protection, industrial hygiene, and occupational safety (especially chemical safety and ergonomics). Senior NTLF staff will then have greater freedom to apply their experience and expertise to the issue of continuing emissions reductions.

As the committee recognized, Williams has the expertise and commitment to execute the desired ongoing program of emissions reductions, but he currently lacks

the time to concentrate on this facet of operations. The same is true of the other NTLF staff, who have shown over past years that they are highly qualified to design and implement programs that produce major safety improvements. Along with Williams, Morimoto and Than have been granted high-profile LBNL awards for emissions reductions and mixed-waste activities over the past six years. With the relief from these tasks provided by a general safety technician, Williams, Morimoto, and Than will be able to focus much more on the planning and implementation of safety improvements at the NTLF. The NTLF staff expect to continue applying the initiative they have already shown in making emissions reductions, informed by their long and varied tritium experience.

The acknowledged need for health physics guidance is readily filled by the accessibility of the large Radiation Protection Group (RPG), headed by Dr. Gary Zeman. The RPG has a staff of 35, including 10 health physicists (HPs). Dr. Zeman has a Ph.D. in Health Physics, and several other staff have Masters-level degrees. A number of the staff are Certified Health Physicists, and others have completed or are completing the first section of their certification. In addition to the health physics staff, the RPG has a staff of Radiological Control Technicians (RCTs) and a technical support staff.

In a fashion similar to health physics support, any general safety technician employed at LBNL has ready access to the many safety professionals currently working in the LBNL EH&S Division, with specialties in environmental protection, waste management, industrial hygiene, and occupational safety.

Administrative control of the NTLF radiological work is accomplished through a Radiological Work Authorization (RWA), renewed each year and voted on by the LBNL Radiation Safety Committee, comprising Laboratory senior scientists. An HP and a RCT are assigned to each activity (or RWA) to assist with design of experiments and any other radiation safety issues. In the case of the NTLF, the RCT is supported under the NTLF NIH funding to carry out a range of tasks, including swipe monitoring and some waste disposal activities. These activities, too, will be among the responsibilities of the "safety support" technician. We will

also seek increased participation in NTLF issues by the assigned HP under the RWA program.

In summary, we believe that adequate support of the current staff will fully address the committee's concerns about access to health physics expertise. Indeed, we feel that the range of expertise represented in current staff is preferable to the focused competence of a single specialist. The ongoing procedural and hardware changes at the NTLF have been a result of many interactions and consultations. NTLF staff interact with many workers in radiochemistry each year and thereby benefit from a wide knowledge base in continuing reduction efforts. The staff also attend scientific meetings of the American Chemical Society, American Nuclear Society, International Isotope Society, Gordon Conferences, California Radioactive Materials Management Forum, the DOE Tritium Focus Group, and other scientific and technical groups. These diverse professional interactions allow for discussions with people from many backgrounds, including health physics and nuclear engineering. In addition, the NTLF benefits from an expert Advisory Committee, specifically constituted to help with ongoing technical and safety issues and to generally review safety activities at the Facility (see below). We believe the range of knowledge and experience available to the NTLF offers greater promise for further emissions reductions than does the expertise of a single health physicist. We are committed to making full use of the available talent.

**2. Improvements in inventory accounting.** The committee recommends that the NTLF "perform accurate inventories of annual tritium inflow vs. outflow, in order to provide a direct independent validation of the quantity of tritium released into the environment." The full requirements for such measurements are daunting. With an inventory of 10,000 Ci and releases of 100 Ci per year (i.e., 1% of inventory) the measurement of inventory would need to be done to 0.1% accuracy to provide an independent validation (to within 10%) of the directly measured tritium emissions. Further, as emissions decrease (only 20 Ci are predicted to be released in 1999), such measurements become even more demanding. In addition, the inventory measurement is really a series of measurements, since the inventory is present in unused tritium, tritium slated for recycling, many waste streams, and

shipped products. Nonetheless, we will investigate methods of better characterizing the tritium inventory in unused and recovered tritium, since these are the largest contributors to inventory. We note, however, that many other issues need to be balanced when considering a change in inventory accounting procedures: Will the new procedures increase staff exposure? Will the new procedures increase the potential for accidental tritium release? What is the safety significance of a highly accurate inventory accounting, since emissions are already directly monitored? The suggestion by NTLF opponents that there is some large source of tritium emissions that is not being measured is not supported by current inventory measurements, personal dosimetry, area monitoring, or environmental monitoring data.

**3. The NTLF Resource Technical and Safety Advisory Committee.** The site safety committee concludes that the Advisory Committee “has not been effective” in overseeing ongoing improvements at the NTLF. Accordingly, the visiting committee recommends that the chair of the Advisory Committee be “an eminent external physicist or medical physicist from outside LBNL,” that the majority of the Committee be from outside LBNL, that it meet annually, and that minutes be recorded. We are happy to accept the advice to appoint an outside chair with appropriate expertise. Further, our intent has indeed been for the Advisory Committee to meet once a year. Following annual meetings in 1995–97, the Committee did not meet in 1998 only because of a heavy load of other reviews and submissions, and the extra activity due to preparation of the NTLF five-year competing renewal. The Committee will meet again in 1999 to review the major accomplishments of mixed-waste processing, to review the implemented changes in tritium monitoring and control, and to give advice aimed at achieving further improvements. We also accept the site safety committee’s advice regarding recording of minutes and recommendations.

However, we regard the total tritium and radiological experience of the NTLF Advisory Committee, as currently constituted, as quite remarkable, and we value its advice. The Advisory Committee was constituted by the NTLF to serve several functions: to review ongoing activities, to review proposed changes, and to offer advice on required changes. In the areas of waste management, industrial hygiene

and safety, and environmental assessment, the internal safety staff at LBNL were considered to be highly qualified and were enrolled as members of the Committee. In the specific area of tritium technology and safety, it was decided that LBNL had insufficient expertise, leading to the recruitment of members from the DOE complex and industry. We find it hard to envisage a more experienced and competent group of tritium technology advisers than the members of the current Committee.

**4. Probability of releases.** The Safety Analysis Document (SAD) for the NTLF makes the conservative assumption that the probability of a total release of inventory is 1.0, then calculates the resultant dose to the public. The only imaginable scenario leading to total release is a fully involved fire of sufficient intensity and duration to desorb all the tritium in inventory and convert it all to HTO. The resulting dispersion leads to very low dose and low health risk. No other scenario leads to either complete release of inventory or complete conversion to HTO. The SAD also includes six other “common activity” scenarios, each with a probability of 1.0, but each with a lower tritium release from a logical release point. An example is a tritium loading incident that releases 2000 Ci of tritium gas from the B75 stack, with 1% conversion to HTO.

The probabilistic analyses suggested by the committee can be done, but we believe that they would contribute little to the operational safety of the Facility. It is not so much a matter of whether they are required by regulation (they are not), but whether they are merited by the overall hazards of the operation. For example, it is not clear how the use of the hazard analysis techniques described could have had any direct influence on the outcome of a single accidental release event, such as that of July 24, 1998. The scenario of that accident, while not explicitly listed in the SAD, is certainly bounded by the scenarios discussed there. We see the greatest value for hazard analysis studies in repetitive, standard operations, such as those in a manufacturing context. The situation is different at the NTLF, where the work is research, with its attendant uniqueness. Under normal operations, only a small fraction of the tritium inventory is ever at risk for release (generally less than 100 Ci per operation). The NTLF staff considers the processes used in each experiment, the possible failure modes, and their probable effects, to minimize risk during the

experiment. We strongly believe that the extensive experience of the staff, together with real-time feedback on releases, is more effective than any formal analysis that might attempt to assess the (very low) probability of a release in any operation.

**5. Settings for air monitors.** We are currently studying the feasibility of lowering the alarm threshold of the air level tritium monitor. However, it should be emphasized that the monitor output is constantly recorded (for later review) and is closely monitored by staff during experiments. In our view, having an alarm sound (particularly if responding to short-lived fluctuations) would serve no useful purpose. The rule of thumb used at the NTLF is 2.5 mrem/hour at 1 DAC (20  $\mu\text{Ci}/\text{m}^3$ ), which is certainly not an emergency level.

A review of past air monitoring data and a comparison with bioassay results demonstrate the protectiveness of our approach. Only one individual at the NTLF regularly receives more than a 100-mrem exposure from tritium—for example, a dose of 153 mrem in 1997. The 1997 average air concentration was 0.08  $\mu\text{Ci}/\text{m}^3$ , twice that of any other year since 1994. Assuming this individual spent 500 hours in B75–103 at this average concentration, the resultant uptake would have been ca. 70  $\mu\text{Ci}$ , yielding a dose of 5.6 mrem, or less than 4% of the individual's actual 1997 dose. Nevertheless, we will continue to review air monitoring data and to assess the relationship between room air concentration and total tritium uptake by NTLF workers.

### ***Concluding remarks***

We conclude with some more-subjective observations. First, by the committee's own testimony, the H-RA by McKone and Brand was a highly conservative document. For example, it overestimated by a factor of ten exposures of workers in the immediate vicinity of the NTLF, as compared to actual, measured exposures. And yet the committee chose to increase by a factor of two the H-RA's exposure estimates and by another factor of two the exposure-based risk estimates. Since the public and the media tend to seize on single numbers, often paying scant attention to the process by which they were derived, we hope the committee will revisit its

decision to add further factors of conservatism to the already-conservative estimates of the H-RA.

The NTLF operates in a community that includes vocal and active opponents of the Facility's operation. These individuals—and at times the local media—have shown a willingness in the past to misuse or distort public information about the NTLF. In this context, we hope, above all else, that the committee will clarify its conclusions with regard to estimated exposures and cancer risks in a way that will preclude their misinterpretation, either purposeful or inadvertent. We therefore especially urge the committee to consider the comments we offer in the first paragraphs under "Corrections and clarifications." We feel that if the committee's findings with regard to the "perimeter" of the Facility are misapplied to the public at large, the resulting controversy could imperil the operation of the Facility itself.